Part 1. Report Cover

Report Number: DLAF022 **Report Date:** 29 Jun 01

Previous Report Number: 99KPT21 **Report Date:** 2 Sep 99

Title: Performance Oriented Packaging Testing of a Grade 3C, Fiberboard Box, Style RSC, 12" x 12" x 12" (ID), Containing 500 Milliliter (19 oz.) Aerosol Cans (Quantity 16), Individually Wrapped in Poly Foam, Packaging Group II

Responsible Individual: Francis S. Flynn

Performing Activity: LOGSA Packaging, Storage,
and Containerization Center
ATTN: AMXLS-T
11 Hap Arnold Boulevard
Tobyhanna, PA 18466-5097

Performing Activity's Reference(s): 9HTRR; TE 35-97;
AMC 13-88

Report Type: Interim Final

DTIC Distribution: N/A

Requesting Organization:
Defense Logistics Agency
Defense Distribution Center
ATTN DDC J-3/J-4-0
2001 Mission Drive
New Cumberland PA 17070-5000

Requesting Organization's Reference(s):
DLA Memo, 6 Dec 00

Test Results: ___ single _X_ combination ___ composite

Section I. Pre-test Conditions

For initial testing, one box was received in new condition, from the DDTP post box fabrication shop.

The following identification schema designates the packaging specimen used for the test(s) indicated.

Specimen No.	Test
A	stack test
A	repetitive-shock vibration test
A	flat onto bottom, drop test
	flat onto long side, drop test
	flat onto top, drop test
	flat onto short side, drop test
	bottom corner, drop test

Section II. Summary

A. Drop test - 1.2 m **PASS**

flat onto the top (face 1)	PASS
flat onto the bottom (face 3)	PASS
flat onto long side (face 4)	PASS
flat onto short side (face 6)	PASS
bottom corner (5-2-3)	PASS

B. Leakproofness test -
restrained under water/soap over seams N/A

C. Internal pressure test/Hydrostatic pressure test (liq.) - N/A

D. Stacking test - static load, 300 lb, 24 hr **PASS**

E. Vibration standard - repetitive-shock, rotary motion 4.3 Hz., 1 hr **PASS**

F. Water resistance test (fiberboard box) - **PASS**

G. Compatibility test (liq. in plastics) - N/A

Test Results (continued)

Section III. Discussion

A. Drop test: *49 CFR §178.603*

___ cold conditioned (0° F, 72 hr)
_X_ ambient conditions (~72° F)
___ standard conditions (50% RH & 23° C)

No.	Ht.	Orientation	Results
A	1.2 m	Flat onto box bottom (3)	Pass/No leaks/rupture; entire contents retained
A	1.2 m	Flat onto box long side (4)	Pass/No leaks/rupture; entire contents retained
A	1.2 m	Flat onto box top (1)	Pass/No leaks/rupture; entire contents retained
A	1.2 m	Flat onto box short side (6)	Pass/No leaks/rupture; entire contents retained
A	1.2 m	Diagonally onto bottom joint corner (5-2-3)	Pass/No leaks/rupture; minor crushing of the 5-2-3 corner; contents retained completely within the box

Specimen A, a combination packaging (16, 500ml, aerosol cans in a 12" x 12" x 12", Grade V3C fiberboard box) was dropped from 1.2 meters onto all 4 flat sides and the bottom manufacturers joint corner (5-2-3). There was no noted leakage, rupture of, or damage to the cans. There was minor crushing of the 5-2-3 corner. The cans did not migrate from their original position in the box.

In conducting the drop test, all five drops (flat bottom, flat long side, flat top, flat short side, and bottom corner) were performed on the same configuration. The decision to use the same container (configuration) for all five drop orientations was based on the relatively minimal damage demonstrated during previous testing of grade V3C, fiberboard boxes with different inner containers or articles. Five drops per configuration exceeds *49 CFR §178.603* requirements, as well as both UN and ASTM recommendations (i.e., one drop on a side or corner per box). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Material. Also per this policy, any failed orientation(s) can be repeated using another configuration.

B. Leakproofness test: *49 CFR §178.604*

N/A. The leakproofness test was not conducted on the box, because the packaging is not intended for the containment of liquids.

C. Internal Pressure/Hydrostatic Pressure test: *49 CFR §178.605*

N/A. Testing for the maintenance of internal pressure is not required for this configuration.

Test Results: Section III (continued)

D. Stacking test: *49 CFR §178.606*
___ standard conditions (23° C & 50% RH)
_X_ ambient conditions (~72° F)
___ high temperature conditions (104° F)

No.	Length	Type	Load/Force	Peak Force	Results	Stability Maintained?
A	24 hr	Static	300 lb	N/A lbf	Pass	Yes

A static top load (300 lbs) was used for the stack test, because it could hold the load constant for the required 24-hour timeframe. The total top load applied on the empty box was greater than the minimum required for one box based on the outside box height and the gross packaged weight. The top load was to simulate a stack of identical packagings that might be stacked on the packaging during transport.

E. Vibration test: *See 49 CFR §178.608.*

No.	Frequency	Duration	Results
A	4.2 Hz	1 hr	Pass. No leakage, rupture, or damage

To be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of the packaging certification marking (*49 CFR §173.24a(a)(5)*), the vibration test was performed, as a means to determine capability. The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). The test was run for 1 hour, using the plywood box packaging. The packaging was tested using a 2,000-lb vibration table (rotary motion) that had a 1-inch-vertical double amplitude (peak-to-peak displacement) such that the packaging was raised from the platform to such a degree that a piece of steel strapping (1.6 mm) could be passed between the bottom of the package and the platform.

F. Water resistance (Cobb Method) test (fiberboard): *49 CFR §178.516*
As required by the standards for fiberboard boxes, the Cobb Method Test for water absorptiveness was performed on a specimen cut from one box (specimen 3) taken from the same bundle as the box used for rough handling (drop, stack, and vibration) testing.

No. specimens felt side (exterior) 5. Average 105.6 g/m². Standard deviation 3.05. Highest exterior value was 109 g/m². Lowest exterior value was 102 g/m². All of the samples tested were free of printing.

No. specimens wire side (interior) 5. Average 107.6 g/m². Standard deviation 21.66. Highest interior value was 121 g/m². Lowest interior value was 70 g/m².

No. specimens exceeding 155 g/m² 0.

Test Results: Section III (continued)

It should be noted that improper storage and rough handling may break the fibers and abrade the coating of the box, decreasing its ability to resist water absorption. This could result in higher test values. Since commercial boxes are occasionally made with the wire facing (interior) as the exterior side of the box, specimens from both the wire (interior) and the felt (exterior) facings should be tested for water absorptiveness.

G. Compatibility test (plastics packagings only): N/A.

Test Personnel

The following personnel performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein-- Richard D. LaFave, Samuel Baroody, Bruce W. Samson, Timothy L. Reimann, and Karen K. Kimsey

References

A. Title 49 Code of Federal Regulations, Parts 106-180, Spring 2001, current as of 12 Jan 01

B. International Air Transport Association Dangerous Goods Regulations, 40th edition, 1 January 1999

C. ASTM D 4919, Specification for Testing of Hazardous Materials Packagings.

D. ASTM D 999, Standard Method for Vibration Testing of Shipping Containers.

E. ASTM D 951, Standard Test Method Water Resistance of Shipping Containers by Spray Method.

F. TAPPI Standard: T 441 Water Absorptiveness of Sized (Non-Bibulous) Paper and Paperboard (Cobb Test).

G. Recommendations on the Transport of Dangerous Goods, sixth revised edition, United Nations, New York, 1990.

H. DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/ MCO 4030.40A, Packaging of Hazardous Material, 23 Jul 96

I. AFJMAN 24-204/TM 38-250/NAVSUP PUB 505/MCO P4030.19G/DLAI4145.3, Preparing Hazardous Materials for Military Air Shipments, 1 Mar 97

Test Results: Section III (continued)

Equipment

Item	Manufacturer	Serial No.	Calibration Expiration Date
2,000-lb vibration table	L.A.B Skaneateles, NY	G23605	*see note*
5,000-lb compression tester	L.A.B Skaneateles, NY	1107050	4/02
release hook	Gaynes Engr. Co. Franklin Park, IL	18211-1	N/R
Cobb Sizing Tester	Teledyne Curley Troy, NY	4180-A	N/R

Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements.

Appendix A

Test Applicability

Pass/fail conclusions were based on the particular fiberboard box specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

Testing was performed per *Title 49* Code of Federal Regulations.

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). The completion of successful required performance tests does not, by itself, authorize the marking and transportation of the dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous materials and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be construed as blanket certification of any configuration which simply uses the performance tested outer fiberboard box. Packaging paragraphs apply.

RN: DLAF022

Appendix B

Test Data Sheet

Section I. Test Product

Physical State: ___ solid ___ liquid ___ gas _X_ aerosol

Additional Description: Contains Propane/Butane 3.5; N-Octane
KaVo Spray
America

KaVo Dentale Medizinische Instrumente
Vertriebsgesellschaft mbH.D-88400

Biberach/Riss . Germany . Verkaufsnr.2113 . Bestellnr.411 9 650

For MSDS call 1-800-323-8029

Amount Per Container:

Item Weight-- 16 lbs. (16 ea @ 1 lb)
Tare Weight-- 5 lbs.
Gross Weight-- 21 lbs.

Section II. Test Parameters

Drop Height: Ref: *49 CFR §178.603*
___ 1.8 m; 71 in. (PG I, II, & III, SG ≤1.2 or solids)
_X_ **1.2 m; 47 in.** (PG II & III, SG ≤1.2 or solids)
___ 0.8 m; 32 in. (PG III, SG ≤1.2 or solids)
___ from-- ___ PG I: SG x 1.5 m, SG x 59.06 in.
___ PG II: SG x 1.0 m, SG x 39.37 in.
___ PG III: SG x 0.67 m, SG x 26.38 in.

Stacking Weight Formula

Variables		Inputs	Calculations	
h	Height, drum/box	12.5	12.5	
n	# stacked containers	XXXXXX	9.44	
w	Gross Packaging Weight	21		
A	Stacking weight	XXXXXX	**177.24**	**178**

NOTE: A = (n-1)*w

A = applied load in pounds
n = (118/h), minimum number of containers that when stacked, reach a height of 3 m
w = maximum weight of one empty container in pounds

Appendix C

Packaging Data Sheet

Section I. Exterior Shipping Container

Packaging Category: ___ single _X_ combination ___ composite

UN Type: Fiberboard boxes (*49 CFR §178.516*) UN Code: 4G

Specification No.: PPP-B-636; Style RSC; 1.9 lbs.;
12" x 12" x 12" (ID); 12½" x 12½" x 12½" (OD)

Manufacturer: Defense Distribution Depot Tobyhanna, Container Fabrication Branch, Tobyhanna, PA 18466

Date(s) of Manufacture: February 2001

Closure Method: The fiberboard box was sealed (7 strip method) using 2" A-A-1830 clear tape. (See drawing)

Additional Description:

a. A 30" x 30" x .04", 4-Mil-poly bag was first placed in the fiberboard box for the purpose of encapsulating the absorbent and the test product. Approximately 1½ inches of firmly packed, loose-fill absorbent cushioning was placed in the bottom of the fiberboard box. Sixteen aerosol cans were placed on the absorbent. Each aerosol can was wrapped in poly foam. More loose-fill absorbent was then firmly packed around, and over the aerosol cans. The loose-fill absorbent must be firmly packed, especially around the cans. 1½ inches of firmly packed, loose-fill absorbent covered the aerosol cans.

b. For this configuration, either firmly packed, fine grade vermiculite or either of the following, firmly-packed cellulose fiber absorbent products, "HAZMATPAC® Absorbent A-900" or "Absorption Corporation Absorbent GP", can be used without any notable difference in performance. Inner packagings have a tendency to migrate if the loose fill material is not firmly packed, especially along the bottom of the container.

Bag Manufacturer: Quality Packaging Systems of Warren, Inc., 24260-2 Mound Road, Warren, MI 48091-5324

Absorbent Manufacturer: Absorbent GP, 1051 Hilton Ave, Bellingham, WA 98225

Appendix C (Continued)

Section II. Inner Packaging/Article

Quantity of Inner Containers: 16 Capacity: 500 ml (volume)

Specification Type and No(s).: Not identified

Type/Nomenclature: Aerosol spray can

Manufacturer/Distributor: Appears to be of German origin, for use in USA

Material: Date(s) of Manufacture: N/A

NSN: N/A

Tare Weight (empty can):

Filled Weight: 1.0 lb.

Dimensions: 2⅝ in. - diameter (OD); 9¼ in. - height (OD)

Closure Type: Plastic snap on cap

Closure Specification Number(s): N/A

Closure Manufacturer: N/A

Closure Dimensions: 1¼ in. diameter
1⅛ in. height

Secondary Closure: Filament-reinforced tape (2 pc)

Secondary Closure Specification Number(s): NSN-- 7510-00-582-4772
(1) A-A-1687B, Amendment 1 (marked) [canceled Jan 96]
(2) PPP-T-97, type II (medium tensile), class B (transparent) [canceled Jan 96]
(3) ASTM D 5330-93, type II (medium tensile)

Secondary Closure Dimensions: 1 inch wide

Additional Information: Each aerosol can was individually wrapped in poly foam (10½" x 9½") and secured using 1-inch filament tape.

Appendix D

Rationale

The equivalent of Packing Group II (medium danger) testing was requested for a fiberboard box, having as the intended contents sixteen, aerosol cans. The configuration to be tested is intended to be applicable to a large assortment of aerosol products contained aerosol cans in volumes of 500ml or less. For lesser volumes, variations to testing requirements can be found in 49 CFR §178.601(g).

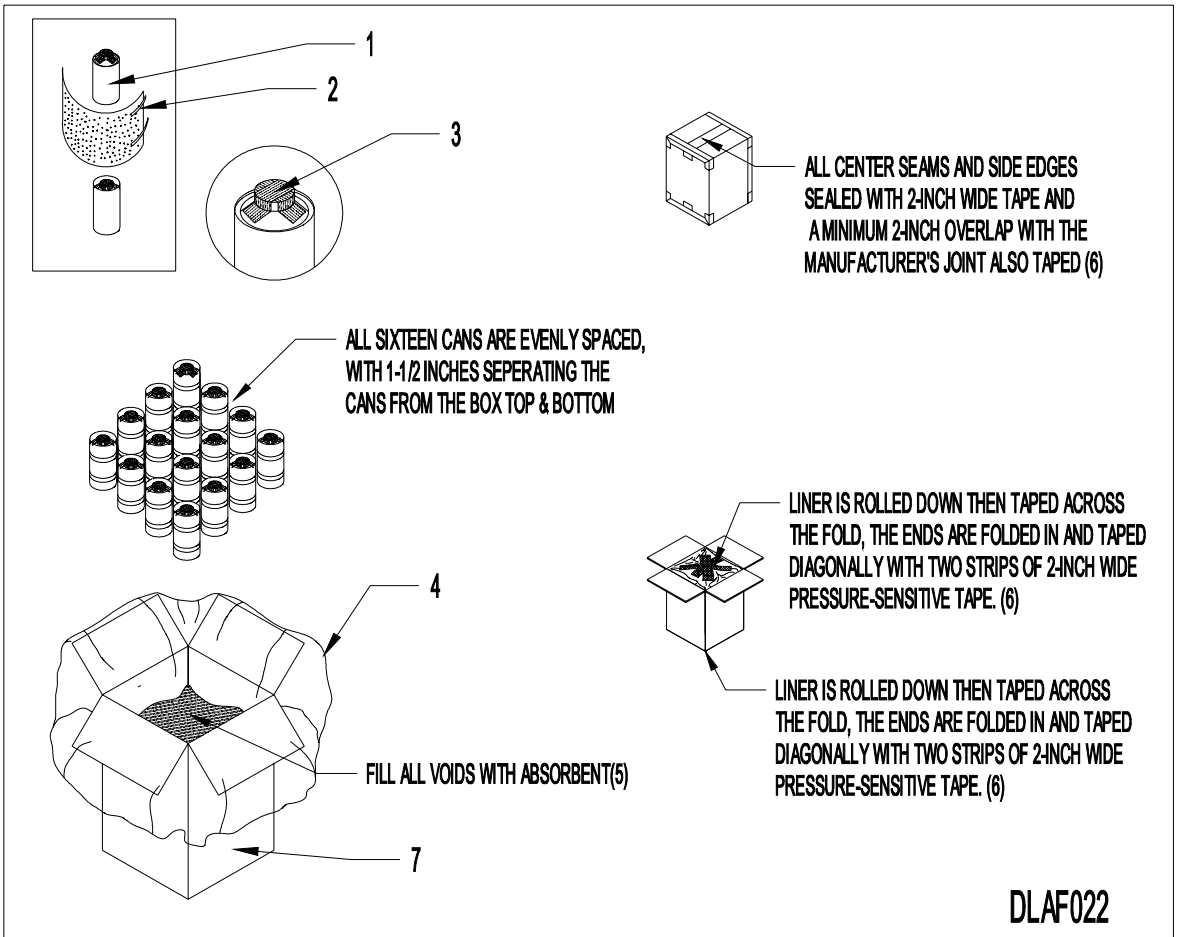
For testing, substitution for the actual hazardous lading is permitted by 49 CFR §178.602(c).

Per the requesting activity, cellulose fiber was used as an absorbent material and/or cushioning.

A secondary closure utilizing filament-reinforced tape was used in accordance with accepted packaging practice.

One combination packaging, made to the above described configuration with 16 aerosol cans, was initially subjected to drop and vibration testing as prescribed in ASTM D 4919. These tests are designed to simulate the shock and vibration a package (configuration) may encounter when being shipped worldwide by truck, rail, or ocean going transport. The order of testing was vibration, then drop testing. Prior to the rough handling testing of the packed fiberboard box, static loading was performed on the empty fiberboard box. This is a U.S. DOT approved method of stack testing, especially when the combination packaging has wide applications.

Drawing



ITEM	DESCRIPTION
1	CAN, ROUND, AEROSOL SPRAY WITH PLASTIC CAP, 500 ml (19 oz), QTY. 16
2	1/4 INCH, POLY FOAM WRAP, APPLIED TO THE CIRCUMFERENCE OF CAN AND TAPED, QTY. 16
3	1-INCH WIDE, PRESSURE-SENSITIVE TAPE, FILAMENT-REINFORCED, IAW ASTM D5330, TY II
4	THE BOX MUST HAVE A PLASTIC LINER, 4-MIL POLYETHYLENE, 30 X 30 X 4 INCHES, BAG (REQUIRED)
5	CELLULOSE FIBER ABSORBENT, OR VERMICULITE, A-A-52450
6	2 INCH, CLEAR PACKAGING TAPE, CONFORMING TO C.I.D. A-A-1830
7	12 X 12 X 12 INCH, WEATHER-RESISTANT FIBERBOARD BOX, STYLE RSC, V3c, QTY. 1